This invention relates to a drill bit and particularly to a self-propelled rotary bit for drilling wells.

In the drilling of deep wells it is customary to use either rotary or impact drills to produce a hole to receive a casing, tubing or other materials for producing fluid from the well. In the utilization of rotary drills either the drill is driven from the surface of the ground through a drill stem or driven by a submersible motor either of the hydraulic or electric type with the motor mounted in proximity to the drill head in a guided housing which is usually provided with a plurality of cables or conduits to supply to the bit the hydraulic or electric power required by the bit.

The heretofore known rotary drilling outfits have required very sturdy and expensive tubings and housings in order to properly operate the drill bits. The present invention provides a self-propelled rotary bit having mud jets in the blades for rotating the blades at high rate of speed with respect to the drill bit.

The apparatus of the present invention comprises a drill head having a conduit for supplying fluid or drill mud under pressure into the stud and the drill head is provided with a plurality of blades each of which has a plurality of rearwardly directed openings or jets which propel the blades by the expulsion of the drilling fluid therethrough.

It is accordingly an object of this invention to provide an improved drilling assembly.

It is a further object of this invention to provide an improved drill bit.

It is a further object of this invention to provide a self-propelled rotary drill.

It is a further object of this invention to provide a rotary drill having a plurality of blades, each of the blades being nested within the succeeding blade.

Another object of the invention is to provide means for driving a bit by the expulsion of a drilling mud into the hole.

Other objects and many attendant advantages of the invention will be apparent from the following detailed description taken in conjunction with the accompanying drawings, in which:

Figure 1 is a sectional elevation of a well showing the drill bit and the stud taken substantially on the plane indicated by the line 2—2 of Figure 3;

Figure 2 is a cross section of the junction between the bit and the stud taken substantially on the plane indicated by the line 2—2 of Figure 3;

Figure 3 is a vertical section through the molé bit and the mounting on the stud;

Figure 4 is a cross section through the reaction cutting blades of the drill bit and taken substantially on the plane indicated by the line 4—4 of Figure 3;

Figure 5 is a view similar to Figure 1 but showing a substantially solid tubular supply to the stud;

Figure 6 is a sectional elevation of a core drill according to the invention;

Figure 7 is an elevation partially broken away and in section of a rotary cutter head according to the invention; and

Figure 8 is a bottom plan view of the rotary head of Figure 7.

In the exemplary embodiment of the invention according to Figures 1 to 5, a stud 10 is provided with a drill bit indicated generally at 12 for producing a hole 14 in a strata of the earth. The stud 10 is suspended by means of a cable 16 and drilling fluid or drilling mud is supplied under pressure into the stud 10 by means of a conduit 18.

Preferably the conduit 18 is a flexible tubular device such as a hose or other tube. However, it is sometimes desired to use solid tubing 20 to not only supply fluid under pressure into the stud 10 but to suspend or lift the stud when it is desired to do so. It should be noted, however, that the tubing 20 may be of relatively light weight as compared to the standard drill tubing as the stud 10 is non-rotating and there is consequently no whip or other agitation of the tubing 20.

The drill head 12 comprises a base 22 which is rigidly secured to the bottom end of the stud 10 by any suitable means such as the threaded coupling 24. The base 22 is preferably annular in construction so that the drilling fluid or mud can readily pass from the stud 10 through the base 22 into the drill head. The drill head proper is provided with a substantially conical shape body 26 which has a hollow central portion 28 for receiving drilling mud from the stud 10. A peripheral flange 30 on the body 26 is provided with an interlock 32 in the form of a collar with a turned edge 34 overlying an annular shoulder 36 of the base 22. The turned edge 34 overlying the shoulder 36 provides an interlock so that the drill head 12 is locked securely in rotative position on the base 22.

An anti-friction bearing 40 is interposed between the body 26 and the base 22 for sustaining the weight of the stud and the drilling mud which amounts to several tons.

A plurality of segmental depending fingers 42 are provided on the periphery of the body 26 and extend longitudinally ahead of the stud 10. The fingers 42 are substantially concentric with each other and have a forward cutting edge 44 and a trailing or impulse edge 46. Preferably the concentric fingers are provided with turned rear ends 48 which nest within the forward point 44 of the next succeeding finger. The arrangement of the fingers 42 and cutting edges 44 on the head is such that the head provides a hole 14 of materially greater diameter than the stud 10 so that the drilling fluid or mud may readily pass through between the sides of the stud 10 and the sides of the hole 14 and be delivered upwardly through the top of a well.

Each of the fingers 42 is provided with one or more rearwardly directed and preferably tangentially directed jet nozzles 50 which communicate by means of passages 52 at the interior opening 28 of the core 26. The drilling mud within the stem 10 is delivered under high pressure through the passages 52 to the jet openings 50 and the expulsion of the drilling mud in a rearward direction, as shown by arrow 49, propels the fingers in a forward direction, as shown by arrow 51, and cause them to produce grinding contact with the strata. Since the mud is under extremely high pressure fingers 42 will be propelled at an extremely high rate of speed so that a good cutting rate is maintained.

The jet type of propulsion may be applied to any type
of rotary drill bit. As shown in Figure 6 the rotary jet system is applied to a core drill having a stud 60 having a base 62 rigidly and firmly connected to the bottom thereof by any suitable means such as screw threads 64. Preferably the base 62 is of annular formation substantially identical with the base 22 and has a bearing race 66 on the forward periphery or edge thereof. A drilling head 68 is provided with a substantially conical center bore 70 and an annular mounting flange 72 and an inner race 76 for the retention of roller bearings 74. The cutter head 68 is retained on the base 62 by means of a ledge 78 and a retaining collar 80 which is rigidly connected to the head 68 by any means such as threads 82 and having a ledge 84 overlying the ledge 78 of the base 62.

The cutter head 68 is provided with mounting fingers 90 and 92 on which are mounted rotary cutters 94 and 96. The cutters 94 and 96 are of the type which relieve an upstanding central core 98 which is received in a core barrel 100. The core barrel 100 is mounted in an opening 102 in a cutter head 68 and is preferably rigidly connected thereto by any suitable means such as welding 104. The core barrel 100 extends within the stud 60 and may, if desired, be supported by any suitable means such as a spider 106. Each of the fingers 90 is provided with a rearwardly directed mud jet fed by means of a passage 110 extending from the central bore 78.

The jet propulsion system may likewise be applied to any cutter head and as shown in Figures 7 and 8 is applied to the usual rotary cutter without the core cutting system. The stud 120 is provided with a base 122 on which is mounted a cutter head 124 by means of retaining ring 126. A plurality of cutter supporting fingers 128, herein shown as three in number, although any desired number may be used, are provided with conical cutters 130 which as usual are mounted on studs 132. Each of the fingers 128 is provided with a mud bore 134 which terminates in a rearwardly projecting jet opening 136.

In the operation of the various forms of the device drilling fluid or so-called drilling mud is introduced through either the conduit 18 or 20 into the studs 10, 60 or 120. In either event the drilling mud will pass down through the stud and to the drilling head and pass through the various passages to the rearwardly directed jet openings where the mud will be ejected under a high pressure and cause rapid rotation of the drilling head without any rotation of the studs 10, 60 or 120.

In addition to propelling the drilling head the drilling mud will be ejected into immediate contact with the following cutter so that the cutting action of that cutter will be considerably expedited. Likewise, the drilling mud will move upwardly alongside the studs carrying the cuttings and other loose material from the hole and as is usual this will be discharged at the top of the casing or hole 14 where the mud will be separated from the cuttings and usually is used over.

Because of the rapid rotation of the cutting head the spud and rotary drill head may be used for any type of drilling and even for spudding in. The stud with a rotary drill head in place is simply supported in proper relation for the starting of the hole and mud is pumped into the stud to rotate the drilling head so that the drilling head will produce a hole and because of the rapid rotation of the drilling head with non-attendant vibration which is produced by the usual drill shaft turning the hole will proceed at a rapid rate.

In the modification according to Figure 6, the core barrel 100 is attached to and rotates with the drilling head so that the bit and the core barrel are substantially independent of the stud 60.

The mounting of the core barrel 100 on the drill head facilitates the sealing of the core barrel to the drill head so that the mud under pressure can only escape through the jet propulsion openings.

For purpose of exemplification particular embodiments of the invention have been disclosed, and described according to the best present understanding thereof. However, it will be apparent to those skilled in the art that many changes and modifications can be made therein without departing from the true spirit of the invention.

Having described the invention, what is claimed as new is:

1. A drill assembly comprising a tubular stud, a drilling fluid conduit connected to the upper end of the stud, an annular base connected to the lower end of the stud, a drill head rotatably mounted on the annular base in a depending relationship thereto, a hollow central portion on the upper end of said drill head communicating with the tubular stud and drilling fluid conduit through the annular base, a plurality of peripheral fingers depending from said drill head, cutting means carried by said fingers and fluid passages communicating with said hollow central portion of said drill head and extending into each of said depending fingers, the lower portion of each passage being directed inwardly and rearwardly on each finger to terminate in a jet opening on the inner surface of each finger, whereby drilling fluid ejected under pressure through said passages results in rotation of the drill head.

2. The structure as set forth in claim 1 wherein said cutting means comprises a forward cutting edge integrally formed on each of said fingers.

3. The structure as set forth in claim 1, wherein said cutting means comprises rotary cutters extending inwardly of each finger.

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